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PROJECT CHECO SOUTHEAST ASIA REPORT

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Project CHECO was established in 1962 to document and analyze air operations in Southeast Asia. Over the years the meaning of the acronym changed several times to reflect the escalation of operations: Current Historical Evaluation of Counterinsurgency Operations, Contemporary Historical Evaluation of Combat Operations and Contemporary Historical Examination of Current Operations. Project CHECO and other U. S. Air Force Historical study programs provided the Air Force with timely and lasting corporate insights into operational, conceptual and doctrinal lessons from the war in SEA.

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PROJECT CHECO
Contemporary Historical Evaluation of Combat Operations
REPORT

USAF SEARCH AND RESCUE

JULY 1966-NOVEMBER 1967

19 JANUARY 1968

HQ PACAF

Directorate, Tactical Evaluation
CHECO Division

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SEAsia Team

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19 January 1968

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FOR THE COMMANDER IN CHIEF

Edward C. Burtenshaw

EDWARD C. BURTENSHAW, Col, USAF
Chief, CHECO Division
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FOREWORD

Since the last CHECO study, "USAF Search and Rescue in SEA" (1961 to June 1966), was distributed, significant changes have contributed to an increase in pilot rescue and recoveries. These techniques and equipment improvements are discussed in "Search and Rescue" for the period July 1966 to November 1967. Special emphasis is placed on the urgent need for accelerated development of an aircraft which will satisfy the distinct combat aircrew recovery mission of the U.S. Air Force.

Responsibility for supporting and maintaining operational control of the Search and Rescue organization rests with Headquarters, 3d Aerospace Rescue and Recovery Group located at Tan Son Nhut Air Base, Republic of Vietnam. It provides coordination vital to the successful accomplishment of the Rescue mission, "That Others May Live."

SEARCH AND RESCUE

1. Area of Responsibility

Aerospace Rescue and Recovery Service has been performing the deep penetration combat rescue role in Southeast Asia since December 1965. The vast area of responsibility for the 3d Aerospace Rescue and Recovery Group (ARRG) is divided into five sectors (Fig. 1). It covers 1.1 million square miles, and of this area, 700,000 square miles encompass jungle land masses of Southeast Asia. [1/]

2. Command and Control

a. The Commander, Seventh Air Force (7AF) as Search and Rescue (SAR) Coordinator for the Southeast Asia (SEA) subregion, has operational control of USAF's primary and secondary SAR forces located there. He exercises this control through a Joint Search and Rescue Center (JSARC) operated by the 3d ARRG, under his Directorate of Aerospace Rescue and Recovery (DAR) at Tan Son Nhut AB, RVN. This facility enables him to direct SAR forces prepositioned at strategic locations throughout his area of responsibility. Equipment and personnel from all services are also available to assist in rescue services, because of the expansive area requiring SAR coverage and the limited number of primary SAR vehicles available there. [2/]

b. A vital control source in the SAR effort is the Crown HC-130 aircraft, which serves as an aerial Command Post.

c. Another control source is the On Scene Commander (OCS), whose responsibility normally rests with the first pilot over the rescue area,

until arrival of the SAR forces.

3. 3d Aerospace Rescue and Recovery Group

The 3d Aerospace Rescue and Recovery Group (ARRG) is assigned to the Pacific Aerospace Rescue and Recovery Center (ARRC) of the Aerospace Rescue and Recovery Service (MAC), with operational control under the Commander, Seventh Air Force.

To accomplish SAR coverage for the expansive area in Southeast Asia, the 3d ARRG exercises control over these units:

Unit	Location
Joint Search and Rescue Center	Tan Son Nhut AB, RVN
OL 1, 3d ARRG, RCC	Son Tra, RVN
OL 2, 3d ARRG, RCC	Udorn AB, Thailand
37th Aerospace Rescue and Recovery Squadron	Da Nang AB, RVN
Detachment 1	Nakhon Phanom AB, Thailand
Detachment 2	Udorn AB, Thailand
38th ARRS (plus 14 associated Dets)	Tan Son Nhut, RVN
39th ARRS	Tuy Hoa AB, RVN

a. JSARC

The Joint Search and Rescue Center (JSARC) is the central coordination agency for all SAR activity within the 7AF area of operations. Although it has responsibility for coordination of SAR activity within a broad area, its primary mission is to direct recovery of downed airmen in the combat zone. 3/

[redacted]

GEOGRAPHICAL AREA of RESPONSIBILITY for SAR

1. Saigon SAR Sector.....JSARC, Tan Son Nhut, AB RVN
2. Da Nang SAR Sector.....RCC, Da Nang AB, RVN
3. Udorn SAR Sector.....RCC, Udorn AB, Thailand
4. Gulf of Tonkin SAR Sector.....Seventh Fleet CTU 77.0.1 or as assigned
5. Bangkok SAR Sector .....RCC, Don Muang AB, Thailand

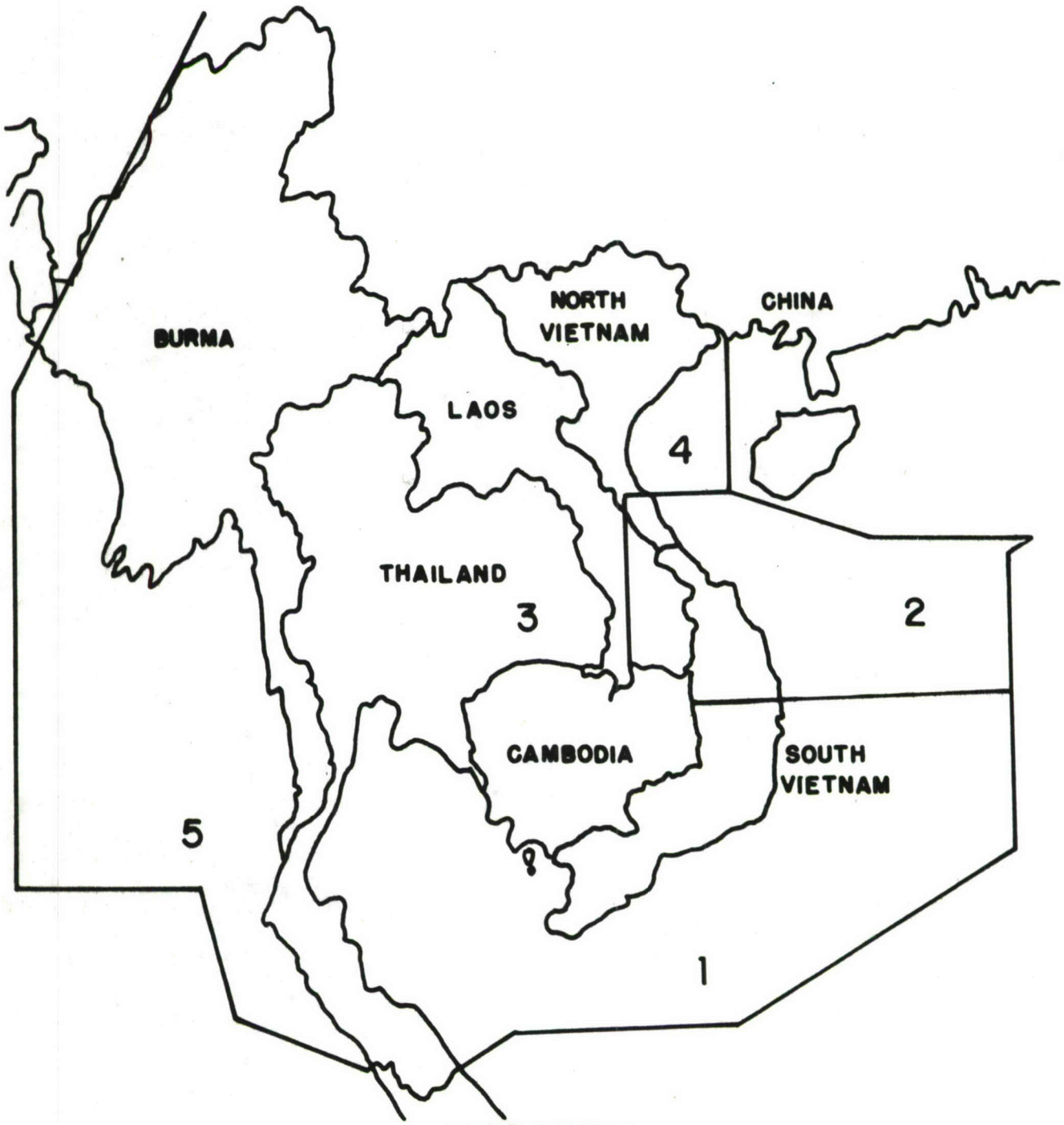

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Figure 1

The JSARC in the 7AF Command Post, Tan Son Nhut AB, RVN, is physically located in a connecting building with Headquarters, 3d ARRG. It is manned 24 hours a day, seven days a week by an Officer Controller, Enlisted Controller, and Radio Operator. The Officer Controller receives tactical operations plans daily from the USAF and USN for the next day's activities, and after careful analysis of them, prepositions rescue forces accordingly.

This organization's two main extensions, Rescue Coordination Centers (RCCs), are located in the Tactical Air Control Centers (TACCs), one at Son Tra, RVN, and the other at Udorn AB, Thailand. When direction is received from these centers to launch a SAR mission, it is recognized as coming from the Southeast Asia SAR coordinator; however, aircraft on the 3d ARRG-directed missions remain under operational control of the Commander, 3d ARRG. Examples of directed missions include positioning and SAR/support type missions, which have been requested by him. 4/

There is also a contingency Rescue Coordination Center under control of the 7AF/3d ARRG, which is organized under the Commander, 631st Combat Support Group, Don Muang Airport, Thailand. It is responsible for SAR efforts within the Rangoon Flight Information Region (FIR).

Special equipment of the JSARC includes HF radios, plus direct land lines to vital facilities, such as Udorn RCC, Son Tra RCC, CRC, III DASC. In addition to these, land lines accommodate 7AF agencies such as the in-country and out-country command posts. Plans call for incorporation of a

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JSARC in which the Army and Navy would have a representative physically present for faster and closer coordination of all agencies. JSARC representatives also provide briefings for new aircrews and pilots aboard USN aircraft carriers when they arrive in the theater.

b. OL 1 and OL 2

By late 1967, the two Rescue Coordination Centers of the JSARC were fully capable of handling all rescue operations within their respective areas of responsibility. During a mission, firm coordination is established between the RCC, which controls the SAR Task Force after it arrives on the scene, and the TACC which selects the force to be used, arranges refueling, and recycles the force into the SAR area. The RCC/TACC controllers maintain close contact with the commander of the HH-3E units during a mission for advice on tactics. 5/

c. 37th ARRS

Located at Da Nang AB, RVN, with a detachment at Nakhon Phanom AB, Thailand and one at Udorn AB, Thailand, the 37th ARRS utilizes the HH-3E (Jolly Green Giant) and the new HH-53 (Super Jolly Green) helicopters and concentrates on areas in which other types of rescue aircraft could not survive. As might be expected, the environment is too hostile at times for even the Jolly Greens to endure.

The detachments in Thailand employ a preposition plan in Laos to permit the HH-3Es a quicker response time. The detachments in Thailand have a variety of forward bases; some are secure, others are not. The most secure of the Laos forward bases is Lima Site 98 with Lima Site 36 utilized as a

HH-3 Completing Rescue
Figure 2

daytime staging base. Daylight orbits over the Gulf of Tonkin and Laos are also used to provide a minimum response time for areas of high aircrew recovery (ACR) probability in NVN.

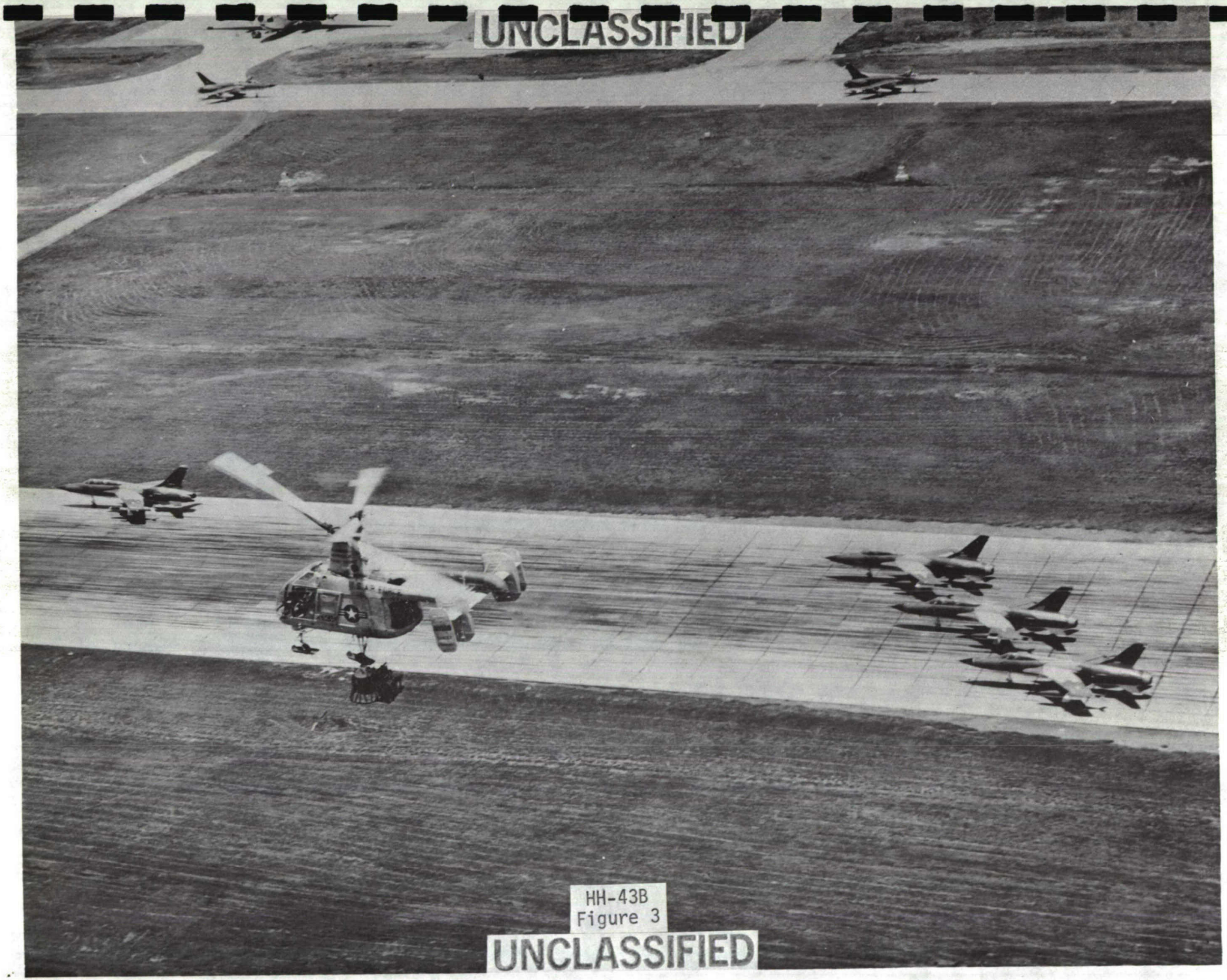
The Da Nang unit deploys two HH-3Es for alert posture at the forward base at Quang Tri, SVN. [6/] Like the Lima sites, Quang Tri could be overrun so rescue forces are repositioned daily there. This repeated repositioning imposes much unprofitable airframe time, and has a direct bearing on the total number of sorties available between periodic inspections. To correct this problem, a rescue aircraft with a response time comparable to, or exceeding forward based aircraft, would allow it to operate out of secure bases.

In conjunction with a slow rescue reaction speed, the HH-3 has a definite power-available limitation. At a 4,000-foot operating elevation and an ambient air temperature of 20°C, the HH-3 is limited to an 18,000-pound hover weight out of ground effect. The basic weight of the helicopter is 14,000 pounds. With the crew, equipment, guns, ammunition, and 2,000 pounds of fuel, the gross weight is 18,000 pounds. With this air temperature and altitude, an HH-3, to effect a successful rescue, must dump fuel to reduce poundage to an allowable hover weight. As the aircraft burns 1,400 pounds per hour of fuel while in a hover, a delicate balancing act is waged between dumping enough fuel to accomplish the rescue, and retaining enough to make it to friendly territory and the tanker for top off. At times, this balancing act is so critical and the fuel so valuable, the crew is obliged to throw equipment overboard. [7/]

At the end of 1967, Detachment 2, 37th Aerospace Rescue and Recovery Squadron, located at Udorn AB, Thailand, was still in training. This unit will augment the previous mission of the HH-3E aircraft, but with greater emphasis on an orbit concept. It will be using HH-53B helicopters (two of which arrived in SEA on 15 September 1967), and A-1s for RESCAP in its orbit concept. Due to the very limited depth of the HH-53 resources, there are insufficient airframe hours to allow an all-airborne method of operation.

The HH-53B, a twin jet, turbine-powered, aerial refuelable helicopter, is armed with three miniguns. Its normal gross weight is 36,000 pounds with a useful load of 13,000 pounds. Fitted with armor plating and self-sealing fuel tanks, the HH-53B has a top speed of 170 knots and a V-Dash speed of 196 knots.

As with most new units and aircraft, the 2d Detachment and HH-53B were not without their share of problems. It was discovered that the co-pilots arriving from Eglin Combat Crew Training Squadron (CCTS) were unqualified in aerial refueling, which necessitated establishment of a field training program. The aircraft developed three mechanical problems of which the first was a leaking hydraulic seal on the spindle of the main motor head. The second problem was a deficiency in the stock starter, requiring a booster motor to aid the engine starter on starts. 8/ The third problem developed in the oil cooler, as the fragile finning collapsed at high speed, impeding the air flow through the cooler. This was resolved by using stiffer fins.



HH-43B
Figure 3

d. 38th ARRS

The 38th Aerospace Rescue and Recovery Squadron (ARRS) utilizes two models of the HH-43, affectionately termed "Pedro": the HH-43B and HH-43F. Serving a dual role in Southeast Asia, these helicopters are used in aircrew recovery (ACR) and crash and airborne fire suppression at 14 air bases in SEA which support tactical aircraft. They are:

Detachment Nr.	Name and Location
1	Phan Rang, RVN
2	Takhli, Thailand
3	Ubon, Thailand
4	Korat, Thailand
5	Udorn, Thailand
6	Bien Hoa, RVN
7	Da Nang, RVN
8	Cam Ranh Bay, RVN
9	Pleiku, RVN
10	Binh Tuy, RVN
11	Tuy Hoa, RVN
12	Nha Trang, RVN
13	Phu Cat, RVN
14	Tan Son Nhut, RVN

A comparison of these models indicates the following:

Item	HH-43B	HH-43F
Self-sealing fuel tanks	Yes, SEA-modified	Yes
Cargo compartment		Yes
Auxiliary fuel tanks	No	Yes, basic wt. 1,000 lbs. more than the B model
Engine - T-53	-1	-11/275 more Shaft HP
Hoist cable length	200' SEA-modified	200'
Tensilized shatter-proof windshield	No	Yes
Communications equipment	UHF ARC-34 ADE Homer ARA-25 ADF Radio Compass FM Radio PRC-25 (Temporary MOD)	UHF ARC-34 ADF Radio Compass ARA-25 VHF-101 FM ARC-44

Located at such widely dispersed bases, the HH-43 is relatively close to any point in South Vietnam and in an ACR role, the crew--pilot, copilot, flight engineer, and pararescue man--can react to notification of a downed aircrewman in a respectable response time despite the model's limitations. These consist of its slow speed of 80 knots, comparatively small 78-nautical mile (NM) radius of action.

In conjunction with these limitations, the HH-43 has a shortcoming in the design of its rotor blades. Composed of a spruce main spar plywood veneer skin, a balloon cloth covering for the wood, and a neoprene rubber leading edge, the blades are vulnerable to sun, wind, and moisture--all abundantly prevalent in SEA. When flight through moderate rain is conducted, it is highly probable that a main rotor blade change will be required, due to separation of the veneer skin. In SEA, the average life per set is 225 hours, due mainly to insufficient protective shelters. 9/

In its fire suppression role, the crew and aircraft are on a 24-hour alert posture to allow a three-minute scramble capability. Should a second emergency arise, a subsequent crew is ready to respond within 15 minutes. For fire suppression emergencies, the "Pedro" usually carries a crew of a pilot, copilot (night or limited weather operation), two firemen, and a pararescue man.

Suspended below the aircraft is a 1,000-pound fire suppression kit, which is basically a metal container. It holds 78 gallons of water and five gallons of concentrated foam, which, under pressure, results in the equivalent

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HH-43 with Fire Fighting Equipment
Figure 4

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HH-43 Reeling in Forest Penetrator
Figure 5

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of 600 gallons of expendable foam. The established procedure, while in the fire suppression role, is to maneuver the helicopter over the landing or crashed aircraft, so that it is in a favorable position to set the fire suppression kit nearby if necessary. The fire fighters and pararescue men can then employ whatever action the situation demands.

e. 39th ARRS

The 39th Aerospace Rescue and Recovery Squadron (ARRS), located at Tuy Hoa AB, SVN, is the only fixed-wing unit in the 39th ARRG. Equipped with 11 HC-130 Crown aircraft, this unit also placed a back-up aircraft at Udorn AB, Thailand, when operations in Laos and strikes against North Vietnam increased.

Versatile in design modification and qualified in the performance of its assigned task, the HC-130 is equipped with essential radios capable of monitoring and transmitting on designated radio frequency bands. It is positioned in a designated orbit and is strategically situated to provide the highest degree of assistance, while remaining at a relatively safe distance to survive SAM and MIG threats. 10/

When the aerial refuelable HH-3E appeared, the role of the HC-130 expanded into that of an airborne tanker. The usual procedure was to have the HH-3E top off prior to heading for the assigned orbit position 30 minutes prior to the first time on target of the strike. During a rescue effort, if some fuel is jettisoned to reduce the gross weight of the HH-3E, another rendezvous and refueling is accomplished prior to RTB.

The first big breakthrough contributing to a rapid response of a downed airman was the air refueling capability for the HH-3E. On 21 June 1967, the 7AF fragged its first combat aerial refueling between an HH-3E Jolly Green Giant and an HC-130.

This air refueling capability allows the rescue force to remain in a preselected orbit near areas of high-strike activity, and provides a minimum reaction time for downed airmen. 11/ The four primary orbit areas are now located in: Central Laos, Northern Laos, and two in the Gulf of Tonkin. An alternate is located in Central Laos, north of the primary Central Laos orbit area. (See Fig. 8.)

Although not yet used, another capability of the HC-130 is the surface-to-air recovery system, referred to as the Fulton Aircrew Extraction System or air snatch. It is compatible only to the HC-130 aircraft, due to the "Skyhook", a forked device on the nose of the aircraft. This operation employs a special kit paradropped to the rescuee, who has the responsibility of setting up the rig in preparation for the pickup. When the survivor retrieves the kit, he dons the harness, inflates the balloon, and lets out the 550-foot nylon lift line. Meanwhile, the HC-130, making a low pass (450 feet) at an airspeed not exceeding 130 knots, catches the line with the Skyhook. The elasticity of the nylon line induces a relatively low (5G) lift off for the rescuee, who is then reeled into the aircraft.

This system has two disadvantages: (1) A clearing is required large enough to insure that the rescuee will clear any obstruction (In a

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HC-130 and HH-3E Prior to Hook-up
Figure 6

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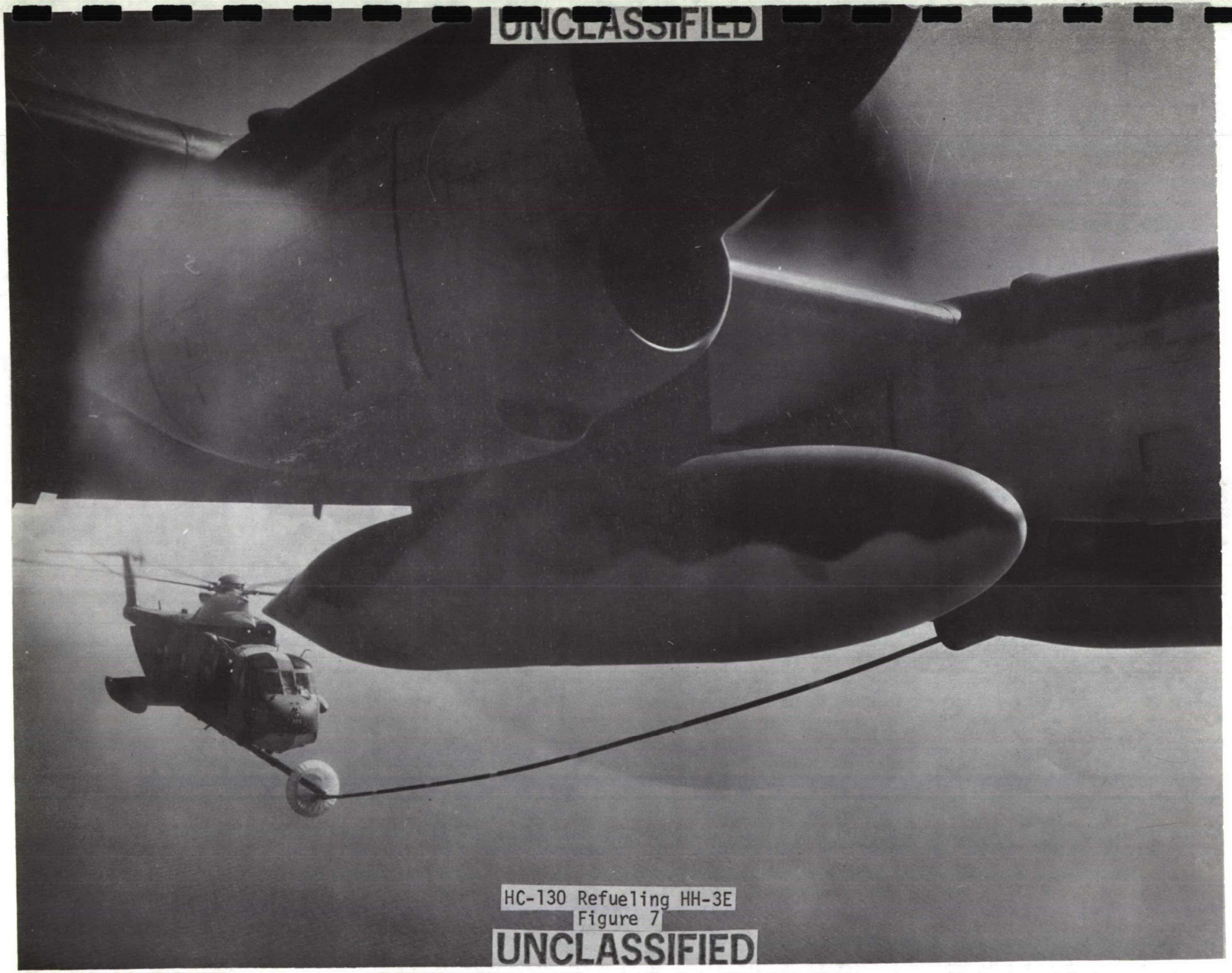

HC-130 Refueling HH-3E
Figure 7

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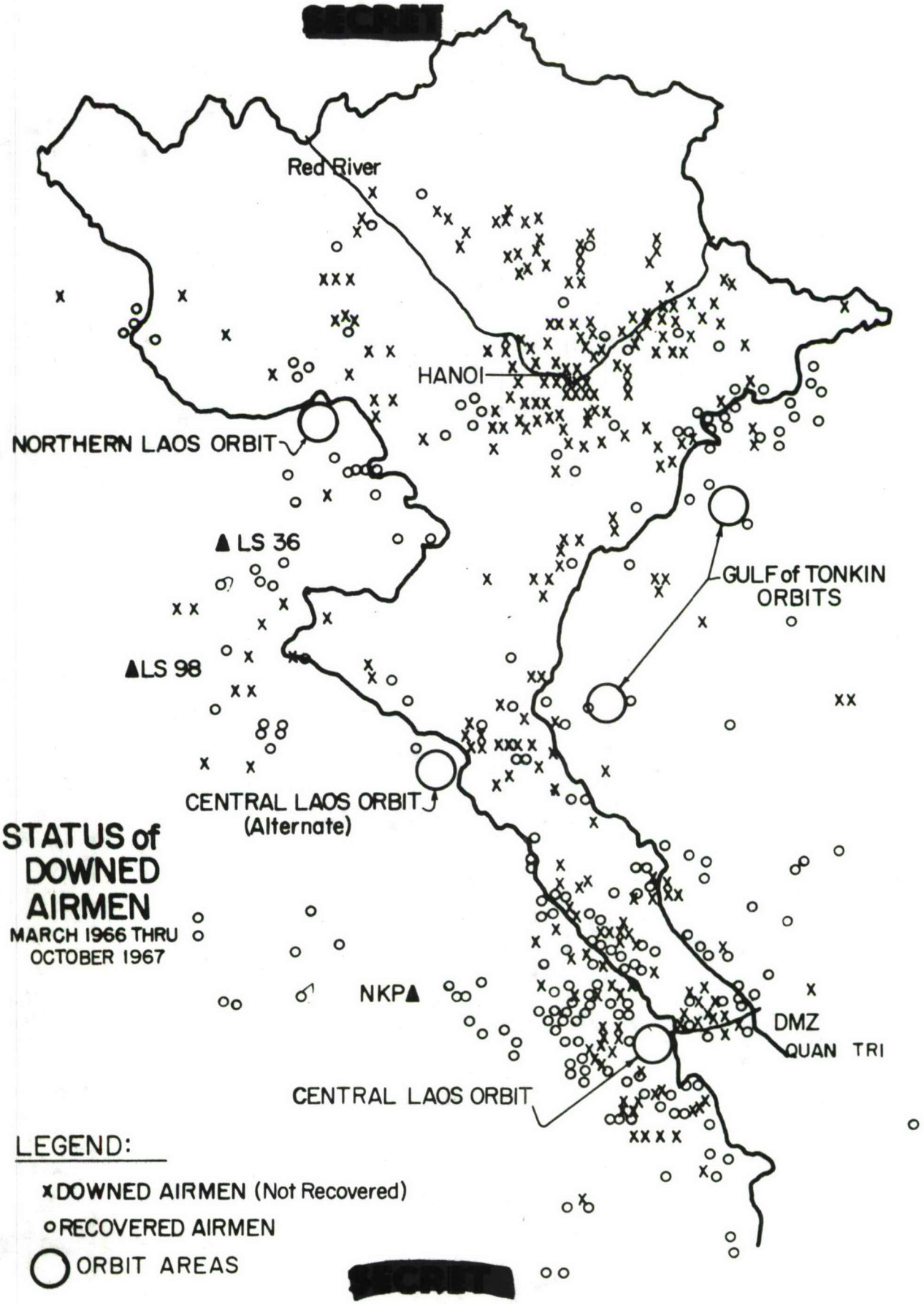
SECRET
Red River
HANOI
NORTHERN LAOS ORBIT
LS 36
LS 98
GULF of TONKIN ORBITS
CENTRAL LAOS ORBIT (Alternate)
STATUS of DOWNED AIRMEN
MARCH 1966 THRU OCTOBER 1967
NKP
DMZ
QUAN TRI
CENTRAL LAOS ORBIT
LEGEND:
DOWNED AIRMEN (Not Recovered)
RECOVERED AIRMEN
ORBIT AREAS
SECRET

Figure 8

100-foot forward distance, the rescuee should be high enough to clear a 100-foot obstacle.); and (2) If the rescuee is incapacitated, he will be unable to set up the kit for retrieval and must rely upon assistance. 12/

4. RESCORT

Very important to rescue efforts are the Sandys or A-1E Rescue Escort (RESCORT) aircraft, which are part of the 602d Air Commando Squadron. They have no significant speed edge over the HH-3E, but with a dual responsibility of protecting the Jolly Greens and locating and flying cover for survivors, they must have a quicker response time, which requires airborne alert.

The Sandys and Jolly Greens stationed at Udorn receive frags on raids in their areas of responsibility. Departing from Udorn, four Sandys will plan to arrive in an orbit over Lima Site 36 or Lima Site 98 before the first TOT. They will maintain this posture until 30 minutes after the last TOT, in readiness for a rescue mission. When notification of downed airman is received, two of the Sandys depart the orbit for the rescue site. Their job is to locate and protect the airman, neutralizing defenses in the area before arrival of the Jolly Greens. The two remaining Sandys stay in orbit awaiting the liftoff of the two rescue helicopters, giving them protection while they are en route to the rescue area. If the rescue is heavily defended and the Sandys have not suppressed the ground fire, they will notify the Jolly Greens to stay in a safe area. Once the Jolly Greens are cleared in, one HH-3 remains high while the other performs the actual rescue. 13/

5. Airborne Mission Control

The sources from which notification of a downed airman can come are many and varied. The HC-130 Airborne Mission Control aircraft usually receives distress calls first, and relays any available information to the appropriate RCC or JSARC. If an emergency exists, the appropriate center alerts/scrambles the rescue forces, depending upon the location and nature of the situation. Normally the responsibility of conducting/controlling the on scene rescue will be given to the Crown aircraft orbiting the respective RCC area of responsibility where the mission is taking place. Flexibility of the system, however, allows a Crown aircraft from one area to assume control of a mission in another location.

The Airborne Mission Controller has an alliance with the SAR forces, to assemble, maintain, and employ as the mission dictates, and to submit progress reports to the Joint Search and Rescue Center at least every five minutes while the rescue effort is in progress. 14/

6. Forward Operating Locations

Due to a combination of low-reaction speed, plus an insufficient number of flying hours, the Forward Operating Location concept came into being. Combat experience, along with an analysis of combat data, shows that a downed airman stands a very good chance of rescue if he does not land in a heavily populated area. Analysis has also shown that if the rescue aircraft can get to a downed airman within 15 minutes, he stands the best chance for rescue. If the Search and Rescue forces take more than 30 minutes, his probability of rescue deteriorates rapidly. 15/

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HC-130 with Skyhook
Figure 9

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Fulton Aircrew Extraction System
Figure 10

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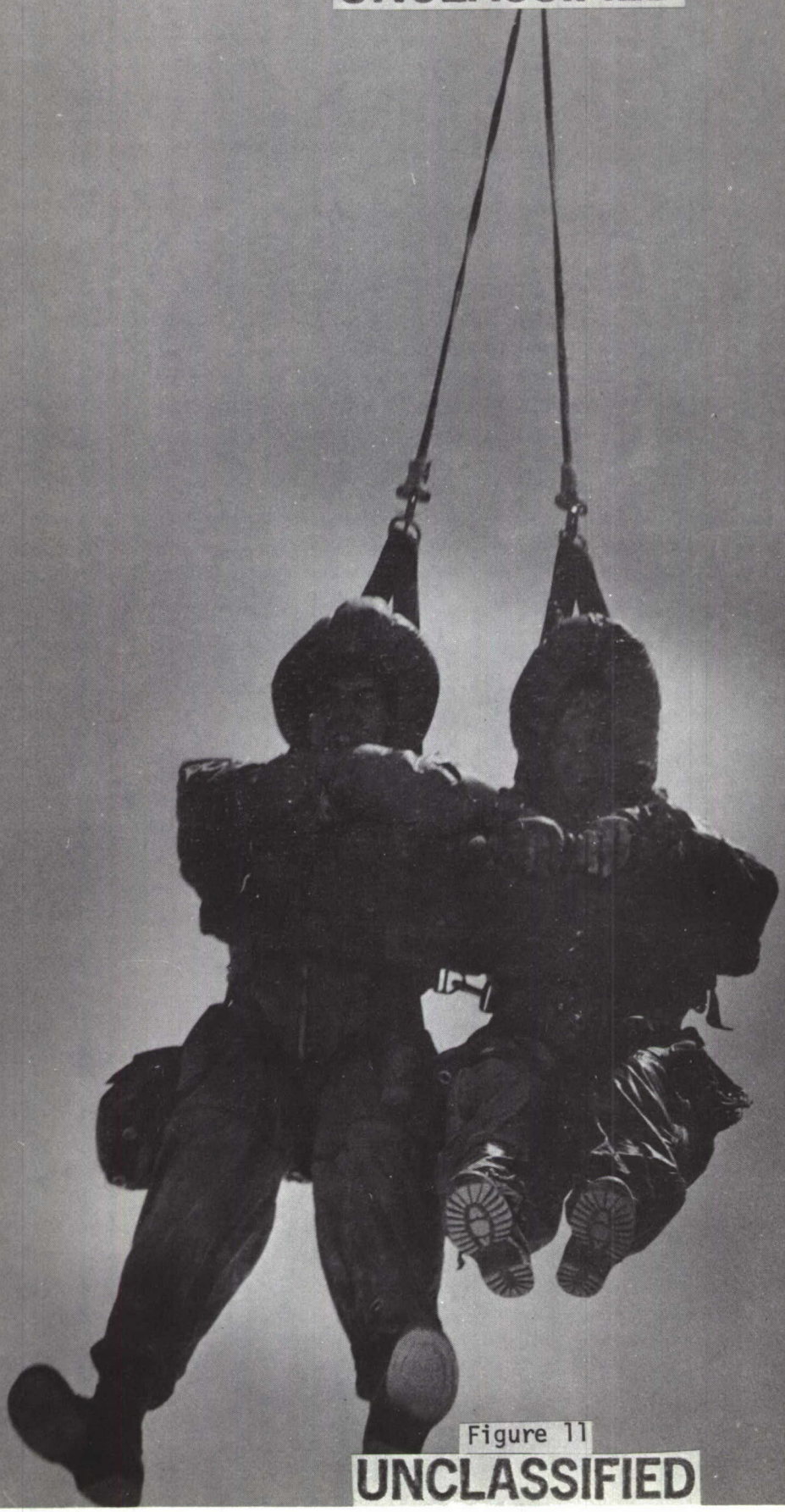

Figure 11

From March 1966 to February 1967, of 14 airmen listed as missing in action, one killed in action, and one captured, all were directly related to response time. The approach of darkness before the rescue forces could arrive accounted for another seven airmen missing in action. Twenty-three downed airmen were denied attempted rescue because of the recovery aircraft's slow speed. 16/

To reduce the time/distance factor, the 3d ARRG utilized three Forward Operating Locations (FOLs) as close as possible to the North Vietnam border for strip alert. These are: Lima Site 36 and Lima Site 98 in Laos, and Quang Tri, SVN. Of the three FOLs, only Lima Site 98 is secure enough to allow the SAR force to remain overnight, so this results in excess shuttling and unproductive airframe time. The normal procedure for positioning the Jolly Greens is to have them depart Nakhon Phanom in pairs early enough to arrive at Lima Site 36 or Lima Site 98 during first light. From these FOLs, the Jolly Greens have a response time of five minutes from alert until airborne, plus the flying time to the rescue area. 17/

7. Orbit Concept

The use of these three Forward Operating Locations increased the rescue percentage of pickups. Operation activity areas shown in Figure 8 and the plotted positions of downed airmen, those recovered and not recovered in and around North Vietnam, clearly define areas of heavy defenses and consequently areas the SAR forces are obliged to operate. Because of the concentration of ground troops, a downed airman can be quickly located and captured. A quicker response time would lead to a greater percentage of rescues. Thus

the orbit concept came into being. Orbit locations are selected to provide the minimum reaction time to the areas of high aircrew recovery probability (Fig. 8). Orbits located at approximately 19N-106.15E, 20N-107.07E, are utilized for the Gulf of Tonkin, depending upon the fragged strike areas. The northern Laos orbit is located at 20.45N-104.10E, the central Laos orbit at 16.50N-106.25E, and an alternate of 18.35N-105E, again dependent on the strike location. The Gulf orbit, fragged for airborne coverage, was dependent on strike periods while the Northern and Central Laos orbits are in use only during high strike periods. Strip alert posture at FOLs are fragged during periods when the force is not in orbit. 18/

8. Refueling in SEA

The refueling missions for the deep Gulf orbit, up to 20 degrees north and higher, are aimed at the recovery of crew members downed in the Gulf or Hanoi/Haiphong area. To afford these airmen a rescue opportunity, the rescue force must be capable of sustained operations in this environment. To support an operation of this type, a procedure has been worked out with the Navy to obtain refueling from certain surface vessels which are operating in the Gulf of Tonkin, in the event air refueling from the HC-130 is not possible due to adverse weather or equipment malfunctions. The only prerequisites are that the vessels be equipped with JP fuel, a hose, and a suitable nozzle for fuel transfer. The fuel transfer can be accomplished by hovering alongside the vessel, or in an extreme emergency, a landing on the deck of larger destroyers is possible.

9. Rescue Is a Team Effort

The end product of the actual rescue of a downed airman does not start, as in days past, with the Mayday call. It starts days before with the planning and preparation, so the crews and aircraft concerned will be in a position at the forward bases. The following is an example of how the Thailand prepositioning phase of the operation works: 19/

> *"Two HH-3s would depart NKP for an advanced base such as Lima Site 36 in Laos early the morning of the strike. Along with the HH-3s will be four A-1E type aircraft. These aircraft will be for RESCORT (rescue-escort) for the Jolly Greens and fire suppression while in the rescue area. The A-1Es will be on station in orbit at the FOL at the first fighter time on target. The orbit will be of the maximum endurance variety to provide the loiter time necessary during the duration of the strike mission. This orbit provides a quick response capability to the A-1E allowing the Rescue portion of the Task Force to be on the way toward the rescue area when the first notification of an aircraft down is received at the RCC. The Rescort aircraft attempts to locate the pilot and provide assistance to him."*

The following is an actual account of a rescue effort on 5 October 1966: 20/

> *"The pilots ejected from their F-4C near Na Son (NVN). Two HH-3Es and four A-1E's were scrambled to the scene. Sandy 31 (A-1E) contacted the two downed pilots who reported that one had a sprained ankle and the other a broken leg. The low element (Jolly Green 36) was turned over to Sandy 41 and 42 after Sandy 31 and 32 had expended their ordnance and declared bingo fuel. Sandy 41 escorted Jolly Green 36 across a ridgeline in the vicinity of the sighted parachute. Jolly Green 02 remained high, directly over the survivors. After Jolly Green 36 was established in a hover over the pilot, ground fire opened up. The helicopter received several hits and pulled off to a safer area. The downed pilot reported that he was hit and losing consciousness. The Sandy's made more strafing passes, trying to suppress the ground fire. Jolly Green 36 was called down for a second try. This time, the copilot, who was less*

than 100 yards directly below the pilot, vectored Jolly Green 36 in to close proximity. Ground fire caused them to pull off after receiving several more hits. After still more suppression from the Sandy's, Jolly Green 36 made a third pass. More hits were taken after establishing a hover close to the copilot. Battle damage was unknown but the paramedic reported a slight shrapnel wound and that the hoist was jammed. It was suspected that hits had been taken in the hoist. The paramedic of Jolly Green 36 returned fire throughout their three attempts, expending six clips of M-16 ammunition. Jolly Green 36 pulled out of the area at 0255Z and received permission to return to base. On the second and third passes the flight mechanic observed the pilot lying prone with his head slightly downslope. Jolly Green 02 requested that they be allowed to accompany Jolly Green 36 back as the extent of the battle damage could not be ascertained and Jolly Green 56 and 53 were en route to the area as backup. After proceeding about 12 miles South, "Compress" advised Jolly Green 02 to return to the scene, attempt the pickup, and report bingo fuel. Fuel state at this time, 0305Z was 1900 pounds. Sandy's one, two, three, and four were in the area at this time to relieve Sandy 41 and 42 who had also expended all ordnance and reached bingo fuel. Upon returning to the location, Sandy three took Jolly Green 02 into the area, Jolly Green 02 had positive sighting of the parachute. Entry was made up in a small valley on an approximate heading of 70°. Jolly Green 02 then turned to parallel the slope to 30° and was established in a hover over the copilot when ground fire opened up again. Jolly Green 02 pulled off to a safer area after taking two hits in the right side of the aircraft in the vicinity of the cargo door. The Sandy's again attempted to sterilize the ridgeline where the firing was suspected to be from. Jolly Green 02 was called down again using the same entry. Again no ground fire was received until the aircraft was established in a hover, close to the copilot. Jolly Green 02 took one hit which completely penetrated the armor plating glanced off internally, penetrated the floor, and ruptured the forward fuel cell. The paramedic and flight mechanic both received slight cuts from shrapnel. The odor of smoke filled the aircraft and they retreated to a safe area. It was thought later to be the odor of cordite. The Sandy's were requested to go in and hit them again. Jolly Green 02 was within 20 minutes of bingo fuel. The crew elected to try once more as the weather in the area was deteriorating. This attempt was successful with no known hits, although the paramedic

heard ground fire. At the time of the rescue, the upper ridges were in the clouds and visibility had dropped to two miles in haze and smoke. At no time during their attempts was the pilot sighted. Jolly Green 02 had reached bingo fuel and was advised to recover to base where arrangements had been made to air evacuate the recovered copilot in a C-123."

10. New Ideas and Concepts

Desperately needed in the Southeast Asia rescue effort are more HH-53s equipped with an integrated night and low visibility system. In the hours of darkness or low visibility, rescue helicopters are, for the most part, ineffective for rescue and recovery, especially in mountainous terrain. A number of factors enter into the problem, such as navigation to the search area, terrain avoidance, as in rugged or mountainous areas, the descent to a hover mode, positioning the rescue craft over the downed airman, and finally, the establishment of the hover not to exceed a wander of five to seven feet laterally nor altitude deviations of greater than five feet.

A number of methods to solve these problems have been tried with varying degrees of success, as in the positioning situation. A combination of TACAN and Doppler can bring the helicopter to within five miles of the objective from a distance of 100 miles. This area is then reduced to within approximately 500 feet of the downed pilot by updating of the navigational position from a spotter plane and by homing in on the downed pilots emergency transmitter. Further use of this homer within this area is restricted due to the large angular deflections caused by the rapid convergence of the homers bearing information. The rescue helicopter must then visually locate the person to be rescued to within 10-15 feet in order to hover overhead and lower the hoist and accomplish the pickup. 21/

Certain basic elements of the helicopter mission are common, whether the mission is flown under visual or nonvisual conditions. First the aircraft must gain its objective area via some type of navigational equipment. This can be accomplished to a far greater degree of accuracy using LORAN C/D, a sophisticated LORAN, capable of treetop-level navigation with repeatable accuracies of 60-400 feet over the areas of Vietnam, Laos, Thailand, Cambodia, and offshore waters. The advantage of using LORAN over another type of navigational method is basically twofold: (1) The repeatable accuracies, and (2) The capability to use terrain masking to avoid detection while performing ingress and egress to the rescue area. This poses a problem of terrain avoidance. By incorporating a terrain clearance/avoidance radar, a helicopter can be flown at night or under adverse nonvisual conditions at low altitudes without direct visual contact of the terrain. 22/

Low Light Level Television (LLLTV) has the capability of operating down to 10^{-5}-foot candles. It is possible to distinguish a man-size target at 200-300 feet under moonlight conditions (10^{-4}-foot candles), but the major disadvantage is that there must be some light; moreover, haze or overcast conditions proportionally reduce the effectiveness of LLLTV. The advantage of this system is that no special equipment--such as a beacon transponder--is required by the downed pilot. 23/

Infrared (IR) detection has shown the most promise of all range locating devices. It is based upon the assumption that the object to be detected has a different temperature and emissivity than its environment. Temperature differentials of three degrees celsius are within the thermal sensitivity

capabilities of present infrared detectors. Because people have a comparatively large temperature difference as opposed to their surrounding, they make infrared targets. No external lighting is required, nor do shadows degrade the system. Typical detection ranges of four-five miles could be used for search patterns and the minimum detection ranges associated with radars and beacons are nonexistent for IR systems. The limiting factors are the ranges at which detection is to be accomplished, the temperature differential existing between the object and its environment, and identification of the downed pilot as opposed to possible troops in the area. 24/

Another device is the automatic Hover Coupler. Once the downed pilot is located, arriving at, and establishing a hover are then essential. The Doppler radar set ground speed signals (lateral and longitudinal) will be compared with a zero ground speed reference and through a coupling, be introduced into the flight controls to maintain zero ground speed within limitations of the Doppler radar threshold. The signal is also integrated to provide the system with zero state errors and position stability. With incorporation of these innovations, a capability is realized whereas previously, approaching darkness or weather necessitated cessation of rescue operations. 25/

Though restricted in its use, but capable of introducing new concepts of operation, the application of incapacitating agents (CS) would be a great benefit to the SAR operating environment. When used in the vicinity of downed airmen to prevent hostile forces from capturing them, this tactic would allow the safe ingress/egress of the SAR forces even though hostile

troops were in close proximity to the survivors. Since CS gas has no long term undesirable effects upon those exposed to it, the agent could be expended against unmasked survivors. However, the downed crewman's position must first be ascertained as he will also be incapacitated and unable to assist in the rescue effort. Under such circumstances, the masked para-rescue men aboard the recovery helicopter would be lowered to help survivors find and board the forest penetrator seat.

The A-1 would "prep" the area with CS bomblets. Upon impact, the bomblets would disseminate the agent, while being propelled along the ground, by the thrust from the burning CS pyrotechnic mix. One A-1 can carry enough CS to effectively cover several acres, and effects will last five to 30 minutes depending on meteorological conditions. Use of this agent against unmasked troops firing on SAR aircraft from hidden jungle positions should suppress them effectively while the rescue helicopter is committed to the pickup position. 26/

11. CARA

Headquarters, 3d ARRG, conducted a study to determine the necessary features required in a rescue aircraft to make it completely compatible with the rescue effort. Included in this report covering the period of March 1966 to February 1967, was an operational analysis to aid in vital Combat Aircrew Recovery Aircraft (CARA) decisions; it focused on factors contributing to, and impeding, successful saves. The results of the operational analysis, coupled with actual Southeast Asia SAR combat experiences, dictate that the single most important parameter to successful combat aircrew recovery

is to minimize the time from which the pilot bails out of his aircraft until he is rescued; in other words, the ability of the Search and Rescue forces to react swiftly to this airman's needs.

During the period of this analysis, 89 percent of the downed airmen survived the bailout or crash landing in a hostile environment. The total airmen shot down for this period was 470, of which 419 survived the landing. Of this group, 197 airmen had no SAR effort exerted on them, due to a variety of circumstances that ranged from a completely unlivable environment for the SAR force to actually observing the pilot being captured or killed. This left 222 rescue opportunities, of which 173 were successful. Of the 49 unsuccessful remaining attempts, 23 were directly attributed to lack of speed, either in getting to the man before he was captured or killed, or the reaction time was too slow to permit reaching the downed airman before darkness set in. This slow reaction time also allows the enemy to develop a defensive position, since he has time to move weapons and troops into the prospective rescue area. Through combat experience, it has been found that once the rescue forces are in the immediate area, automatic small arms fire has been the greatest deterrent to successful rescue. Another factor that has become apparent through combat experience and detailed analysis of SAR mission reports, is that a downed airman has the best chance, providing he has not bailed out into a heavily defended area, if the rescue aircraft can get to him in 15 minutes. The more time that passes, the less chance he has for survival, and if it takes the SAR forces more than 30 minutes to reach the downed airman, his chance of being successfully rescued deteriorates rapidly.

To overcome the time element, an aircraft with a faster response time is needed, and to determine how much faster, a review of the operating area is apropos. Route Packages V and VI have accounted for 60 percent of the combat sortie losses, while receiving only 16 percent of the total sorties. Since more airmen are downed in these highly defended areas, this is where the major SAR effort should take place. The current SAR force has had only minimal success (Appendix I) in Route Packages V and VI. In comparison, 50 percent of the downed airmen were rescued from Route Packages I - IV, while 22 percent were recovered from Route Packages V and VI. The pie-shaped area north of Hanoi between the Red River from Hanoi, northwest to the Chinese border, and the railroad complex from Hanoi northeast to Lang Son is presently denied to SAR forces. The heavily defended Red River and railroad complex to Lang Son denied 88 airmen a SAR effort. Twenty-nine airmen downed along the Gulf of Tonkin coast were denied rescue because of the heavily defended coastline.

In considering the distance from the northernmost Forward Operating Location, Lima Site 36, to Hanoi (which is 150 miles), the speed time plot on Figure 12 shows that the CARA, with a five-minute reaction time, must be capable of 1,000 knots TAS to reach the downed airman in the desired 15 minutes. Using the 30-minute criterion, a 360-knot TAS would be required. In this instance, the desired speed bracket for the CARA should be between 360 and 1,000 knots TAS. In Appendix II, a comparison of the HH-3, HH-53, one CARA traveling at 400 knots and the other at 1,000 knots, indicates the vulnerability time of each aircraft to different sized AAA weapon systems.

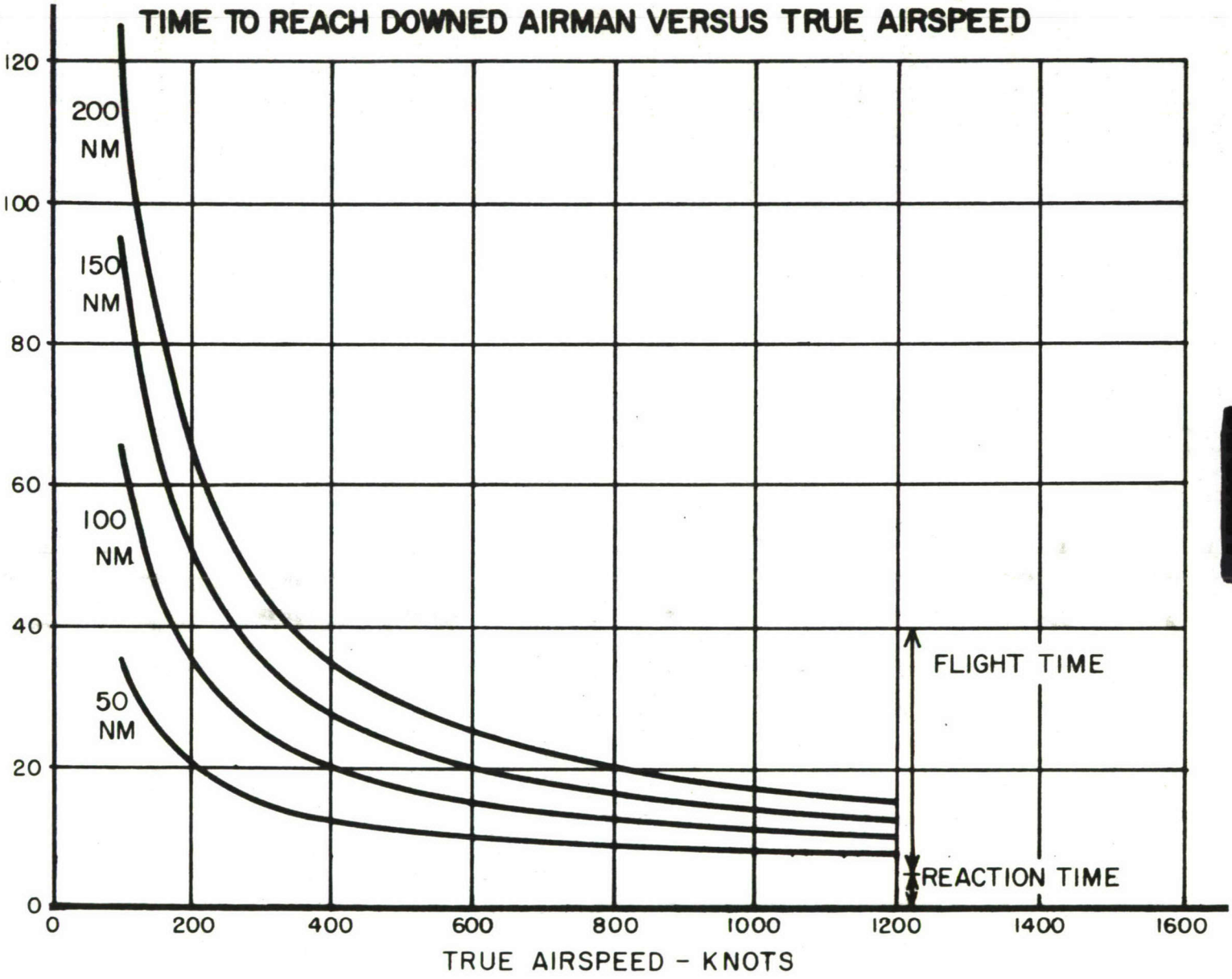
TIME TO REACH DOWNED AIRMAN VERSUS TRUE AIRSPEED
120
100
80
60
40
20
0
200 NM
150 NM
100 NM
50 NM
FLIGHT TIME
REACTION TIME
0
200
400
600
800
1000
1200
1400
1600
TRUE AIRSPEED - KNOTS
TIME - IN MINUTES

Figure 12

This again indicates that to survive such a hostile environment, speed is an essential element. Speed alone is not the complete answer to survivability, but speed coupled with Electronic Countermeasures (ECM) would assure a lower loss rate. The ECM must provide a capability equal to, or better than that programmed for strike, reconnaissance, and penetration aircraft, and for operation during the CARA time frame to allow a penetration and loiter over highly defended areas.

In addition to ECM, another very important feature CARA must have to be completely useful is night and all-weather rescue capability. 26/

12. The Greatest Effort

Possibly one of the greatest rescue efforts to date developed on 3 October 1967. Ozark 01, the lead aircraft of a flight of F-105s out of Korat AB, Thailand, received hits, forcing him to eject in a populated coastal area south-southwest of Haiphong. At 1716 hours, a few minutes after 01 ejected, Ozark 02 saw the chute on the ground. Four minutes later, Pistol Three, an aircraft in another flight, had radio contact with 01, who relayed, "I'm in good shape." Twenty-five minutes later, and with a total of ten aircraft participating in the SAR effort, a message was received from Ozark 01 telling all aircraft to leave the area because of intense ground fire. The search was then suspended until 0630 hours on 4 October, due to a combination of an unlivable environment and approaching darkness. A rescue task force, consisting of one Crown (HC-130), a Jolly Green (HH-3E), and a Big Mother (Navy SH-3) proceeded into the area with the Crown aircraft holding 30 miles off shore. Dakota, one of the RESCAP aircraft, began picking up a personal

locator beacon, then voice contact with an authentication, but he could not obtain a visual on Ozark 01.

Another RESCAP flight, Electron, south of the area, started receiving ground fire and Electron 1 took a hit in the canopy while in the process of pinpointing Ozark's position prior to arrival of the rescue helicopter. Two other Electrons were escorting the rescue helicopters to the area from the north due to 37/57-mm fire south of the area. At 0834 hours, Electron 504 reported he had the pilot in sight, but as Clementine (the rescue chopper) and the four A-1s were proceeding into the area for the pickup, Ozark 01 recommended, "Do not come in at this time, keep feet wet, stay over water." At 0856 hours, Ozark 01 advised, "I have troops in the area and feel the rescue forces are giving my position away. Pull out at this time." Temporarily, Harbor Master, the SAR destroyer, withdrew all the forces.

At 1220 hours, Electron 505 in the search area received a signal from Ozark and then he spotted the pilot. As Clementine arrived, Electron requested from Ozark a daylight smoke. Ozark was out of smoke so Electron made a low pass to drop a smoke charge for a position for Clementine. As Clementine approached the downed pilot, hits in the helicopter and more critically in the fuel tank, caused Clementine to pull out and attempt to reach the water before flaming out. Just two minutes after taking the hits, Clementine reported, "Out of gas, not going to make it." Clementine successfully ditched ten miles offshore, and shortly thereafter Big Mother 70, a Navy SH-3, recovered all of its crew members safely. All forces withdrew at 1337 hours.

At 1020 hours on 5 October, the Seventh Air Force stated that a maximum search effort for Ozark would commence in the afternoon at 1636 hours. An F-4 flight, Call Sign Vespa, while in the rescue area, picked up a beeper and voice contact with Ozark 01. Vespa now positioned Ozark five miles west of his original position. A report from the Navy stated that the area was very hot. A request was made of the Navy for use of four A-1s and a Big Mother in the morning to support the upcoming rescue effort, which would coincide with an Air Force strike package. An F-105 pilot in the area heard the conversation between Vespa and Ozark, recognized Ozark's voice and submitted this information at flight debriefing, where it was passed on to JSARC. At 1902 hours, a fix on Ozark was obtained by Vespa when Ozark transmitted, "I'm alive, I'm alive, come rescue me." Passes on this area revealed no flak; in fact, the area was very peaceful, with no villages, an unpopulated ridge, and one road, Route 184, in the area. Due to approaching darkness, the effort had to be suspended for the night.

That evening, Seventh Air Force drew up a plan to provide a SAR task force of 16 F-4s, two Jolly Greens, a Crown, four Navy A-1s and a Big Mother. The timing of this force would coincide with Navy and Air Force strikes at 0900 hours the following morning. Crown Four would be at the North SAR point and two Jolly Greens ready to ingress at 0815 hours. An Iron Hand Flight would go in at 0850 hours to locate and establish voice contact with Ozark 01 prior to committing the force.

As it developed on 6 October, Jolly Green picked up voice contact and told Ozark 01 to keep talking in order to establish a fix on his position.

The F-4s also had voice contact and established a position moments later. Locket, the Navy A-1s, heard Ozark say, "I'm alive," and Jolly Green recorded Ozark minutes later as saying, "Alark, Alark, get me some food, then gave the code word, "Advance." A check revealed no significance of such a code word. Locket reported that he didn't think it was the pilot and that it was a bad area for helicopters due to high, hilly, rough terrain. The next transmission from Ozark was recorded as, "Zark, Zark, come and rescue me."

At this point there was little doubt left that this voice wasn't Ozark 01. To be absolutely certain, Locket asked him his wife's name and home town. The response was "I'm alive, I'm alive send me some food," plus the code words "Lamb and Advance." Locket finally spotted the man and relayed to Crown: "Taking fire, RESCAP going in to suppress, I'm sure this is not the man. He is the wrong color." At that point Queen recommended pulling out.

At 0951 hours, on 6 October, almost three days later, Lt. Gen. William W. Momyer, Seventh Air Force Commander, after much consideration, pulled all the forces out. Miraculously only Clementine was lost, as the crew was subsequently picked up. Though every A-1 that took part in the effort received battle damage, all were recovered safely. This valiant rescue attempt vividly brought to the forefront a serious deficiency in the lack of a night rescue capability. 28/

13. Summary

This study discussed existing problems and focused on the need for a rescue vehicle of greater versatility--one which would allow more of our downed airmen an opportunity to be rescued. The 39 percent save rate of the Search and Rescue forces could be improved with availability of an aircraft capable of reducing reaction time, plus an all-weather, and night operational capability.

14. Loss and Recovery Statistics

Divided into five categories, these statistics for the period of June 1966 to November 1967, pertain to out-country losses and recoveries: 29/

- Recovered - Those crew members actually recovered by SAR forces.
- SAR attempted - Environment allowing a SAR force effort to take place but with negative results.
- Killed Outright - Those crew members who were killed in the aircraft and the launching of a SAR effort would be totally unnecessary.
- Captured - Again no SAR effort launched due to the capture of the downed crew member.
- MIA/Unknown - Missing in Action implies the crew's fate was in doubt as to the status after bailout. Unknown refers to specific cases when no one saw the aircraft go down, or the aircraft never returned to base.

Recovered	207	35%
SAR Attempted	77	13%
Killed Outright	90	15%
Captured	34	6%
MIA/Unknown	185	31%
TOTAL	593	100%

FOOTNOTES

1. (S) Reg, 7AF, Nr 64-2, JSAR-SEA, Doc. 1;
   (S) Study II, 3d ARRG, SEA Combat Aircrew Recovery Requirements thru FY 3/72, by Maj John H. McLeaish and Maj John W. Silvis, 21 Mar 67, Doc. 2.

2. (U) Reg, 3d ARRG, Nr 55-10, Ops, Mission Control, 20 July 67, Doc. 3.

3. (C) Hist, 3d ARRG, ARRS (MAC), 1 Jan - 31 Mar 67, Doc. 4.

4. (U) Reg, 3d ARRG, Nr 55-10, Ops, Mission Control, 20 Jul 67, Doc. 3.

5. (U) Ibid.

6. (S) Interview, Lt Col Kenneth Caughran, CO, 37th ARRS, Sep 67, Doc. 5.

7. (C) Interview, Capt Damonte, Standardization Sect, 3d ARRG, 10 Oct 67, Doc. 6.

8. (U) Press Release, 3d ARRG, IO, Sep 67, Doc. 7.

9. (S) Interview, Lt Col John Schaffer and Maj Robert Lee, 3d ARRG, 3 Oct 67.

10. (U) Reg, 3d ARRG, Nr 55-10, Ops, Mission Control, 20 Jul 67, Doc. 3.

11. (C) Extract, Hist, Hq, 3d ARRG, 1 Apr - 30 Jun 67, Doc. 8.

12. (U) Ltr, AROAS, Orlando AFB, Fla, subj: Surface-to-Air Recovery Subsystem, 30 Mar 67, Doc. 9.

13. (S) Interview, Capt Roy, JSARC Duty Controller, 3d ARRG, 3 Sep 67.

14. Ibid.

15. (S) Study, 3d ARRG, SEA Operational Analysis of Required Performance Parameters for a Combat Aircrew Recovery Aircraft, by Maj John H. McLeaish and Maj John W. Silvis, 22 May 67, Doc. 10.

16. (S) Study, 3d ARRG, Limitations to the Recovery of Downed Airmen, by Maj John H. McLeaish and Maj John W. Silvis, 24 May 67, Doc. 11.

17. (S) Extract, Study, Hq 3d ARRG, Incidents of Enemy Action Against 3d ARRG SAR Helicopters/Crew Members, Sep 65 thru May 67, by Maj J. H. McLeaish and Maj J. W. Silvis, 4 Jul 67, Doc. 12.

18. (S) Study II, 3d ARRG, SEA Combat Aircrew Recovery Requirements thru FY 3/72, by Maj J. H. McLeaish and Maj J. W. Silvis, 21 Mar 67, Doc. 2.

19. (S) Interview, Capt Roy, JSARC Duty Controller, 3d ARRG, 3 Sep 67.

20. (C) Hist, 3d ARRG, Aerospace Rescue and Recovery Service (MAC), 1 Oct - 31 Dec 66, Doc. 13.

21. (C) Abstract, Sikorsky Aircraft Corp, Undated, Doc. 14.

22. (S) Ltr, 7AF (DPLR), Status of LORAN C/D in SEA, 31 Jan 67, Doc. 15.

23. (C) Abstract, Sikorsky Aircraft Corp, Undated, Doc. 14.

24. Ibid.

25. Ibid.

26. (C) Rpt, 3d ARRG, Command Correspondence Staff Summary, 1 Apr 67, Doc. 16.

27. (S) Study, 3d ARRG, SEA Operational Analysis of Required Performance Parameters for a Combat Aircrew Recovery Aircraft, by Maj J. H. McLeaish and Maj J. W. Silvis, 22 May 67, Doc. 10.

28. (S) Excerpts, 3d ARRG, JSARC Duty Log, 9 Oct 67.

29. (S) Rpts, 7AF, WAIS, Jun 66 - Nov 67.

APPENDIX I

Loss Rates of Downed Airmen and Probabilities of Surviving 100 Missions - by Route Packages (1 May 66 - 31 Jan 67)

Route Package	Loss Rate	Prob. Surv. 100 Missions
VI	0.78	0.19
V	0.78	0.67
IV	0.00	1.00
III	0.50	0.89
II	0.50	0.93
I	0.50	0.92

APPENDIX II

Maximum Vulnerability of SAR Aircraft to AAA

AAA Weapon, MM	Vulnerability Time, Seconds			
	HH-3E	HH-53B	CARA 400 kts	CARA 1000 kts
12.7	32.7	26.2	9.8	3.9
14.5	45.5	36.2	13.6	5.4
23.0	65.5	52.2	19.6	6.7
37.0	55.5	44.2	16.7	7.8
57.0 on carriage	77.1	60.1	23.2	9.3
57.0 off carriage	197.0	158.0	59.2	23.7
85.0	272.0	218.0	81.4	32.6

GLOSSARY

AAA	Antiaircraft Artillery
ACR	Aircrew Recovery
ARRC	Aerospace Rescue and Recovery Center
ARRG	Aerospace Rescue and Recovery Group
ARRS	Aerospace Rescue and Recovery Squadron
CARA	Combat Aircrew Recovery Aircraft
CCTS	Combat Crew Training Squadron
DAR	Directorate of Aerospace Rescue
ECM	Electronic Countermeasure
FIR	Flight Information Region
FOL	Forward Operating Location
IR	Infrared
JSARC	Joint Search and Rescue Center
Kts	Knots
LLLTV	Low Light Level Television
mm	Millimeter
NVN	North Vietnam
RCC	Rescue Control Center
RESCORT	Rescue Escort
RTAFB	Royal Thai Air Force Base
RTB	Return to Base
RVN	Republic of Vietnam
SAR	Search and Rescue
SARCC	Search and Rescue Coordinating Center
SEA	Southeast Asia
SVN	South Vietnam
TACAN	Tactical Air Control and Navigation
TACC	Tactical Air Control Center
TAS	True Airspeed
TOT	Time on Target

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SECRET

SECRET